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PATENT COOPERATION TREATY



PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2002P08716WO		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/DE2003/001430	International filing date (day/month/year) 05 May 2003 (05.05.2003)	Priority date (day/month/year) 29 May 2002 (29.05.2002)
International Patent Classification (IPC) or national classification and IPC C04B 35/491		
Applicant SIEMENS AKTIENGESELLSCHAFT		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 9 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 15 December 2003 (15.12.2003)	Date of completion of this report 08 November 2004 (08.11.2004)
Name and mailing address of the IPEA/EP	Authorized officer
Facsimile No.	Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/DE2003/001430

I. Basis of the report

1. With regard to the elements of the international application:*

☐ the international application as originally filed

☒ the description: _____, as originally filed
 pages _____ 1-17
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☒ the claims: _____, as originally filed
 pages _____ 1-20
 pages _____, as amended (together with any statement under Article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☐ the drawings: _____, as originally filed
 pages _____
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☐ the sequence listing part of the description: _____, as originally filed
 pages _____
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box IV.

Reference is made to the following documents:

- D1: PATENT ABSTRACTS OF JAPAN, Vol. 1998, No. 05,
30 April 1998 (1998-04-30) & JP 10 001364 A
(TOKIN CORP) 6 January 1998 (1998-01-06)
- D2: MURAKAMI S ET AL: 'Low-temperature luminescence
and energy transfer processes in Eu^{3+} , Nd^{3+} , and
Cr-doped sol-gel PLZT ceramics" TWELFTH
INTERNATIONAL CONFERENCE ON DYNAMICAL PROCESSES
IN EXCITED STATES OF SOLIDS. DPC'99, HYMNIK,
PAART RIO, 23-27 JAN 1999, Vol. 83-84, pages
215-219, XP002258021 Journal of Luminescence,
No. 1999, Elsevier, Netherlands ISBN:0022-2313
- D3: BYKOV I P ET AL: 'Investigation of chromium
impurities charge state and chemical bonds in
PLZT ceramic" JOURNAL OF PHYSICS AND CHEMISTRY
OF SOLIDS, JUL 1995, UK, Vol. 56, No. 7, pages
919-923, XP000889272 ISBN: 0022-3697
- D4: KABA T ET AL: "The study of valence states of
manganese ions in $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3\text{-La}_2\text{O}_3\text{-MnO}_2$ solid
solution by the ER method" FERROELECTRICS
LETTERS SECTION, 1992, UK, Vol. 14, No. 5-6,
pages 135-144, XP008022944 ISBN: 0731-5171
- D5: KABA T: "THE STUDY OF THERMAL STIMULATED SHORT-
CIRCUIT CURRENTS IN MODIFIED $\text{PB}(\text{ZR}, \text{TI})\text{O}_3$ "
CZECHOSLOVAK JOURNAL OF PHYSICS, PRAGUE, C,
Vol. B38, No. 6, 1998, pages 680-688,
XP008022962 ISBN: 0011-4626

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box IV.

Lack of unity of invention

Document D1 has all the features of the first claim when TR stands for manganese. D1 also mentions that the addition of MgO results in an increase in mechanical oscillation quality. This is one of the two effects associated with the use of the composition as per the application (page 2, lines 25 to 28 of the application). The second advantageous effect mentioned by the applicant is that of a greater d_{33} co-efficient.

The applicant has shown in the examples that the addition of a TR element results in an increase in mechanical oscillation quality. However, as already stated, this effect is known from D1. The examples do not, however, show anything relating to the so-called high d_{33} co-efficient. Although d_{33} co-efficient values are indicated on page 6 of the application (lines 17 to 19 and 34 to 37), it is not clear whether these values were actually obtained and if so with which RE and TR elements and with how many of those elements.

If the applicant does not provide proof to show that a higher d_{33} co-efficient was obtained with each of the three TR elements, the three TR elements do not meet the requirement for unity of invention, since this is the only effect that the three inventions have in common.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.

PCT/DE 03/01430

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	7-9, 11-15, 17, 19	YES
	Claims	1-6, 10, 16, 18, 20	NO
Inventive step (IS)	Claims		YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations

1. Disclosure (PCT Article 5), clarity and support (PCT Article 6)

- a. The application contains only examples in which iron or manganese is used as TR element, and does not indicate that the same effects as with Mn and Fe can be achieved when using Cr as TR dopant. Cr does not appear to be an obvious alternative to Mn or Fe. Cr comes from a different PSE group than Fe and Mn and generally has chemical properties that are different from those of Fe and Mn. The applicant could substantiate the fact that the Cr dopant has the same effect as Fe and Mn by submitting new examples or by providing convincing arguments.
- b. With the current wording of claim 1, the ratio between the five different metal ions of the composition from claim 1 is more or less undefined. It would appear, however, from the description that it is essential that the composition of the application be a PZT composition in which RE and TR are dopants. It would appear from page 1, lines 7 and 8 that the following feature is essential to the definition of the invention:

"A piezoceramic composition in the form of a lead zirconate titanate ($\text{Pb}(\text{Ti}, \text{Zr})\text{O}_3$, PZT)".

It would appear from page 3, lines 17 and 18 that the following feature is also essential to the definition of the invention:

"The rare earth metal RE and the transition metal TR are PZT dopants".

Since independent claim 1 does not contain these features, it does not meet the requirement of PCT Article 6 in conjunction with PCT Rule 6.3(b) that each independent claim must include all the technical features essential to the definition of the invention.

- c. It would appear from page 4, line 33 to page 5, line 4 of the description that the following feature is essential to the definition of the invention:

"the composition includes PZT crystals that have a particle diameter of more than 1 micrometer".

Since independent claim 1 does not contain this feature, it does not meet the requirement of PCT Article 6 in conjunction with PCT Rule 6.3(b) that each independent claim must include all the technical features essential to the definition of the invention.

- d. It would appear from the description that it is essential that the TR dopant has a valency of less than 4. There is nothing in the application to show that the desired properties can be achieved when W_{TR}

is 4 or more. Claim 1 thus contravenes PCT Article 6. The possibility of a valency W_{TR} of 4 should also be excluded since with a valency W_{TR} of 4, the values of $b/(4-W_{TR})$ are the same to infinity and z can of course never be greater than infinity. It is therefore also essential that W_{TR} be either 2 or 3. The applicant is therefore requested to indicate in claim 1 that W_{TR} is either 2 or 3, as is shown on page 4, lines 4 and 5 of the application.

e. The current definition of the composition in claim 1 allows the possibility of b being equal to 0. The application contains nothing to indicate that the desired effects are achieved without the presence of an RE dopant and therefore this contravenes PCT Article 6.

f. Claim 7 of the application contravenes PCT Article 6 because the claim is unclear.

2. Novelty (PCT Article 33(2))

a. The applicant mentions on page 4, line 36 to page 5, line 4 of the application that almost irrespective of the sintering temperature, PZT crystals with a particle diameter of more than 1 micrometer are obtained and that PZT with this particle diameter is piezoelectric. The properties of a ceramic normally depend on the composition and sintering process. In the present case, the properties are dependent almost solely on the composition. This means that any sintered ceramic having the composition as per claim 1 is piezoelectric.

b. Claim 2 is drafted as an independent claim, although it appears to be the intention that claim 2 be dependent on claim 1. The further analysis with regard to novelty supposes that claim 2 is dependent on claim 1. If claim 2 is regarded as an independent claim, then it lacks novelty over documents D1, D3, D4 and D5.

c. Regarding claims 5 and 6, the applicant is referred to the PCT Guidelines, III-4.7a: "Characterization of a chemical compound solely by its parameters should, as a general rule, not be allowed. It may, however, be allowable in those cases where the invention cannot be adequately defined in any other way". A ceramic can almost always be adequately defined in terms of its composition or microstructure as well as the formula, phase composition, grain size, density, etc..

It appears that in the present application the ceramic can also be adequately defined without using parameters. Consequently, neither of the two parameters in claims 5 and 6 can be the feature that distinguishes the claims from the prior art.

It can anyhow be assumed that a ceramic having the composition of the claim to which claims 5 and 6 refer, also has the properties of claims 5 and 6, since these properties are the direct result of the specifically chosen composition.

d. Document D1 discloses (in the abstract) a piezoceramic PZT composition that contains 0.07 to 0.50 wt.% MnO and 0.11 to 1.00 wt.% Sm_2O_3 . D1 also defines the ratio of Sm_2O_3 to MnO as being 1.5

to 2.0.

Consequently, in view of the disclosure of document D1, the present application does not meet the requirements of PCT Article 33(1) because the subject matter of claims 1 to 6, 10, 16, 18 and 20 lacks novelty (PCT Article 33(2)).

- e. Without the inclusion in claim 1 of the essential feature mentioned under point 1d of this report, a document such as D2, in which PLZT is doped with Cr^{5+} (page 218, part 3.4), but contains far less Cr^{5+} than La^{3+} , is prejudicial to the novelty of claim 1 of the application.
- f. Document D3 discloses (in figure 2) a piezoceramic PLZT composition that contains 0 mol% La_2O_3 together with 0.25 mol% Cr_2O_3 . Since value b in claim 1 of the application may be 0, this example satisfies the current definition in claim 1 of the application.

The PLZT composition of figure 2d contains 2 mol% $\text{LaO}_{1.5}$ and 2 mol% Cr_2O_3 . This means that z is twice as large as b when W_{TR} is 3. The first line in document D3 provides the definition of the x value in that document (which is the b value in the application). It is specified that x is consistent with the content of $\text{LaO}_{1.5}$. Figure 2 of document D3 does not show whether the Cr_2O_3 content is in mol% or wt.%. Part 3.1 on page 920 of document D3 mentions a chromium content indicated in mol%. Since D3 contains only mol percentages and no weight percentages, it can be assumed that the Cr_2O_3 content in figure 2 of document D3 is in mol%.

Document D3 does not mention that the PLZT compositions are piezoelectric, but this is not relevant to the question of novelty. Since the ceramic compositions from D3 are identical to the ceramic compositions from claim 1 of the application, it can be assumed that the compositions from D3 are piezoelectric and that the particle diameter is greater than 1 micrometer.

Consequently, in view of the disclosure of document D3, the present application does not meet the requirements of PCT Article 33(1) because the subject matter of claims 1 to 6, 10, 16, 18 and 20 lacks novelty (PCT Article 33(2)).

- g. Document D4 discloses (on page 141 and in figure 2b) a PZT composition that contains 0.015 mol% La_2O_3 together with 0.015 mol% MnO_2 . Figure 2b shows that the MnO_2 is divalent, not tetravalent, and must therefore be regarded as MnO .

Consequently, in view of the disclosure of document D4, the present application does not meet the requirements of PCT Article 33(1) because the subject matter of claims 1 to 6, 10, 16, 18 and 20 lacks novelty (PCT Article 33(2)).

3. Inventive step (PCT Article 33(3))

- a. It is not clear what surprising inventive effect is associated with claims 7 to 9.
- b. Silver, copper and palladium are generally known electrode materials. It is not inventive to apply these materials to a sintered PZT layer, since they

can be applied to any ceramic. It is also not inventive to press together a plurality of metallised PZT layers to produce a multilayer structure. The use specified in claim 15 is generally known as the common use for piezoelectric PZT ceramic. Consequently, claims 11 to 15 do not involve an inventive step.

- c. Documents D1 to D4 all use sintering temperatures of more than 1100°C for the RE- and TR-doped PZT ceramics. The low-melting metals that are mentioned in claim 17 can be sintered together with the RE- and TR-doped PZT ceramics from the first claim to produce a dense ceramic, as is mentioned on page 14, lines 1 and 2 of the application. The combination of this density (more than 96%) with the features of either claim 17 or claim 19 could be inventive.

Sintering at a low temperature *per se* is not inventive, since it is always the aim with ceramics to keep the sintering temperature as low as possible. Consequently, claims 16, 17 and 19, as currently worded, are not inventive.

The present application does not meet the requirements of PCT Article 33(1) because the subject matter of claims 1 to 20 does not involve an inventive step (PCT Article 33(3)).